PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

127 # 10

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C07D 451/00, A01N 43/34, C07D 451/02, A61K 31/46 | A1

(11) International Publication Number: WO 98/46600

(43) International Publication Date: 22 October 1998 (22.10.98)

(21) International Application Number: PCT/GB98/00693

(22) International Filing Date: 4 March 1998 (04.03.98)

(30) Priority Data:
9706222.8 26 March 1997 (26.03.97) GB

(71) Applicant *(for all designated States except US)*: ZENECA LIMITED [GB/GB]; 15 Stanhope Gate, London W1Y 6LN (GB).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: GODFREY, Christopher, Richard, Ayles [GB/GB]; Jealott's Hill Research Station, Bracknell, Berkshire RG42 6ET (GB). SALMON, Roger [GB/GB]; Jealott's Hill Research Station, Bracknell, Berkshire RG42 6ET (GB). RUSSELL, Charles, Adam [GB/GB]; Jealott's Hill Research Station, Bracknell, Berkshire RG42 6ET (GB).

(74) Agents: TIERNEY, Francis, John et al.; Zeneca Agrochemicals, Intellectual Property Dept., Jealott's Hill Research Station, P.O. Box 3538, Bracknell, Berkshire RG42 6YA (GB).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: BICYCLIC AMINE DERIVATIVES

(57) Abstract

(I)

The invention concerns a method of combating and controlling insect, acarine or nematode pests which comprises treating said pests, or the locus of said pests, with an effective amount of a compound of formula (I), wherein A is WXC–CYZ or XC=CY; R is hydrogen, formyl or cyano or a group selected from alkyl, aryl, heteroaryl, aralkyl, heteroarylalkyl, alkenyl, aralkenyl, alkynyl, alkoxycarbonyl, alkanesulfonyl, arenesulfonyl, alkenyloxycarbonyl, aralkyloxycarbonyl, aryloxycarbonyl, heterocyclylalkyl, carbamyl, dithiocarboxyl or $X'R^3$ (where X' represents oxygen or a group NR^4), provided that when R is alkenyl, aralkenyl or alkynyl said group does not have an unsaturated carbon atom bonding directly to the ring nitrogen of formula (I); Ar is optionally substituted phenyl or an optionally substituted 5– or 6–membered heterocyclic ring system containing from 1 to 3 heteroatoms individually selected from nitrogen, oxygen and sulfur atoms, and at least one unsaturation (double bond) between adjacent atoms in the ring, said heterocyclic ring being optionally fused to a benzene ring, wherein the substituents, if present, are selected from halogen atoms, cyano, alkyl, alkenyl, alkynyl, alkoxy, haloalkyl, haloalkenyl, alkylthio and alkyl amino groups, any of which groups contain up to six carbon atoms; W, X, Y and Z are, independently, hydrogen, hydroxy, acyloxy, alkoxy, alkylsilyloxy, cyano or halogen; alkyl moieties of R, R^3 and R^4 comprise from 1 to 15 carbon atoms, and are optionally substituted with one or more substituents selected from halogen, cyano, carboxyl, carboxylic acyl, carbamyl, alkoxycarbonyl, alkoxy, alkylenedioxy, hydroxy, nitro, amino, acylamino, imidate and phosphonato groups; aryl, heteroaryl, aralkyl, heteroarylalkyl, alkenyl, aralkenyl, alkynyl, alkoxycarbonyl, alkanesulfonyl, arenesulfonyl, alkanyloxycarbonyl, aralkyloxycarbonyl, aryloxycarbonyl, heterocyclylalkyl, carbamyl, dithiocarboxyl moieties of R, R^3 and R^4 comprise from 1 to 15 carbon atoms, and are optionally substituted with one or more substituents selected from halogen, cyano, carboxyl, carboxylic acyl, carbamyl, alkoxycarbonyl, alkoxy, alkylenedioxy, hydroxy, nitro, haloalkyl, alkyl, amino, acylamino, imidate and phosphonato groups; or an acid addition salt, quaternary ammonium salt or N–oxide derived therefrom; or an effective amount of a composition comprising a compound of formula (I), as hereinbefore defined, and an insecticidally, acaricidally or nematocidally acceptable carrier or diluent therefor. In other aspects the invention concerns compositions comprising a compound of formula (I), certain compounds of formula (I) and processes for making said compounds.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

BICYCLIC AMINE DERIVATIVES

This invention relates to a method of combating and controlling insect, acarine or nematode pests with bicyclic amine derivatives, to insecticidal, acaricidal or nematocidal compositions comprising said derivatives, to certain novel bicyclic amine derivatives and to processes for preparing said novel compounds.

8-Azabicyclo[3.2.1]oct-2-enes are disclosed in J. Am. Chem. Soc. 93 6684-5, J. Org. Chem. 59 2164-71, J. Org. Chem. 49 4405-9, J. Org. Chem. 40 2525-9 and Tet. Lett. 22 5179-80. Pharmaceutical uses for 8-azabicyclo[3.2.1]oct-2-ene derivatives are disclosed in GB2247886, WO97/13770 and WO94/13659.

The invention provides a method of combating and controlling insect, acarine or nematode pests which comprises treating said pests, or the locus of said pests, with an effective amount of a compound of formula (I):

(I)

wherein A is WXC-CYZ or XC=CY; R is hydrogen, formyl or cyano or a group selected from alkyl, aryl, heteroaryl, aralkyl, heteroarylalkyl, alkenyl, aralkenyl, alkynyl, alkoxycarbonyl, alkanesulfonyl, arenesulfonyl, alkenyloxycarbonyl, aralkyloxycarbonyl, aryloxycarbonyl, heterocyclylalkyl, carbamyl, dithiocarboxyl or $X'R^3$ (where X' represents oxygen or a group NR^4), provided that when R is alkenyl, aralkenyl or alkynyl said group does not have an unsaturated carbon atom bonding directly to the ring nitrogen of formula (I); Ar is optionally substituted phenyl or an optionally substituted 5-or 6-membered heterocyclic ring system containing from 1 to 3 heteroatoms individually selected from nitrogen, oxygen and sulfur atoms, and at least one unsaturation (double bond) between adjacent atoms in the ring, said heterocyclic ring being optionally fused to a benzene ring, wherein the substutuents, if present, are selected from halogen atoms, cyano, alkyl, alkenyl, alkynyl, alkoxy, haloalkyl, haloalkenyl, alkylthio and alkyl amino groups, any of which groups contain up to six carbon atoms; W, X, Y and Z are, independently, hydrogen, hydroxy, acyloxy, alkoxy, alkylsilyloxy, cyano or halogen; alkyl moieties of R, R^3 and R^4 comprise from 1 to 15 carbon atoms, and are optionally substituted with one or more

substituents selected from, halogen, cyano, carboxyl, carboxylic acyl, carbamyl, alkoxycarbonyl, alkoxy, alkylenedioxy, hydroxy, nitro, amino, acylamino, imidate and phosphonato groups; aryl, heteroaryl, aralkyl, heteroarylalkyl, alkenyl, aralkenyl, alkynyl, alkoxycarbonyl, alkanesulfonyl, arenesulfonyl, alkanyloxycarbonyl, aralkyloxycarbonyl, aryloxycarbonyl, heterocyclylalkyl, carbamyl, dithiocarboxyl moieties of R, R^3 and R^4 comprise from 1 to 15 carbon atoms, and are optionally substituted with one or more substituents selected from, halogen, cyano, carboxyl, carboxylic acyl, carbamyl, alkoxycarbonyl, alkoxy, alkylenedioxy, hydroxy, nitro, haloalkyl, alkyl, amino, acylamino, imidate and phosphonato groups; or an acid addition salt, quaternary ammonium salt or N-oxide derived therefrom; or an effective amount of a composition comprising a compound of formula (I), as hereinbefore defined, and an insecticidally, acaricidally or nematocidally acceptable carrier or diluent therefor.

It will be appreciated that the bicyclic amine compounds of formula (I) are capable of existing in more than one isomeric form. The present invention embraces within its scope all isomeric forms and mixtures thereof in all proportions.

Examples of 5- and 6-membered heterocyclic ring systems represented by Ar include those based on pyridine, pyrazine, pyridazine, pyrimidine, pyrrole, pyrazole, imidazole, 1,2,3- and 1,2,4-triazoles, furan, thiophene, oxazole, isoxazole, thiazole, isothiazole, 1,2,3- and 1,3,4-oxadiazoles, and 1,2,3- and 1,3,4-thiadiazoles, and partially reduced containing one double bond derived from these, as well as those based on oxathiole, dioxole, and dithiole rings containing one double bond. Preferably Ar represents a halo-substituted phenyl, pyridyl or diazinyl group.

When Ar is a 5- or 6- membered heterocyclic ring fused to a benzene ring it is preferably benzoxazole, indole, benzofuran, benzothiophen or benzimidazole.

Halogen includes fluorine, chlorine, bromine and iodine.

Alkyl moieties preferably contain from 1 to 6, more preferably from 1 to 4, carbon atoms. They can be in the form of straight or branched chains, for example methyl, ethyl, n- or iso-propyl, or n-, sec-, iso- or tert-butyl.

Haloalkyl is preferably C_{1-6} haloalkyl, especially fluoroalkyl (for example trifluoromethyl, 2,2,2-trifluoroethyl or 2,2-difluoroethyl) or chloroalkyl. For R, haloalkyl is preferably C_{2-6} haloalkyl wherein there is no halogen on the α-carbon (for example it is 2,2,2-trifluoroethyl or 2,2-difluoroethyl).

Alkenyl and alkynyl moieties of R and substituents of Ar preferably contain from 2 to 6, more preferably from 2 to 4, carbon atoms. They can be in the form of straight or branched chains, and, where appropriate, the alkenyl moieties can be of either (E)- or (Z)-configuration. Examples are vinyl, allyl and propargyl.

Aryl includes naphthyl but is preferably phenyl.

Heteroaryl includes 5- and 6-membered aromatic rings containing one, two, three or four heteroatoms selected from the list comprising oxygen, sulphur and nitrogen and can be fused to benzenoid ring systems. Examples of heteroaryl are pyridinyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl (1,2,3-, 1,2,4- and 1,3,5-), furyl, thienyl, pyrrolyl, pyrazolyl, imidazolyl, triazolyl (1,2,3- and 1,2,4-), tetrazolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, oxadiazolyl, thiadiazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, quinoxalinyl, indolinyl, isoindolinyl, benzofuranyl, benzothienyl and benzimidazolinyl.

The heterocyclyl part of heterocyclylalkyl is a ring containing one or two heteroatoms selected from the list comprising oxygen, sulphur and nitrogen. Examples are piperidine, piperazine, pyrrolidine, tetrahydrofuran, morpholine, thietane, pyridine or thiazole.

The alkylenedioxy group is a substituent for a ring and is especially C_{1-4} alkylenedioxy. Alkylenedioxy groups are optionally substituted with halogen (especially fluorine) and are, for example, methylenedioxy (OCH_2O) or difluoromethylenedioxy (OCF_2O).

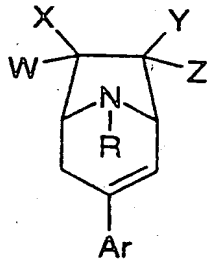
Suitable acid addition salts include those with an inorganic acid such as hydrochloric, hydrobromic, sulfuric, nitric and phosphoric acids, or an organic carboxylic acid such as oxalic, tartaric, lactic, butyric, toluic, hexanoic and phthalic acids, or sulphonic acids such as methane, benzene and toluene sulphonic acids. Other examples of organic carboxylic acids include haloacids such as trifluoroacetic acid.

In one particular aspect the present invention provides a method of combating and controlling insect, acarine or nematode pests which comprises treating said pests, or the locus of said pests, with an effective amount of a compound of formula (I), wherein A is WXC-CYZ or XC=CY {(wherein X, W, Y and Z are independently hydrogen, hydroxy, acyloxy (especially C_{1-4} alkylcarbonyl), alkoxy (especially C_{1-4} alkoxy), alkylsilyloxy (especially C_{1-4} alkylsilyloxy), cyano or halogen)}; Ar is optionally substituted phenyl or optionally substituted 5-or 6-membered heterocyclic ring containing from 1 to 3 heteroatoms individually selected from nitrogen, oxygen and sulfur atoms, and at least one unsaturation

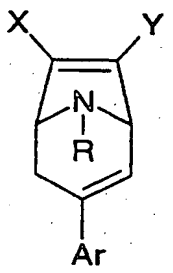
(double bond) between adjacent atoms in the ring, said heterocyclic ring being optionally fused to a benzene ring, wherein the substutuents, if present, are selected from halogen atoms, cyano, alkyl (especially C_{1-4} alkyl), alkenyl (especially C_{2-4} alkenyl), alkynyl (especially C_{2-4} alkynyl), alkoxy (especially C_{1-4} alkoxy), haloalkyl (especially C_{1-4} haloalkyl), haloalkenyl (especially C_{2-4} haloalkenyl), alkylthio (especially C_{1-4} alkylthio), and alkyl amino (especially mono- or di- (C_{1-4} alkyl)amino, such as mono- or di- (C_{1-3} alkyl)amino) groups; R represents hydrogen, formyl (CHO) or cyano or a group selected from alkyl (especially C_{1-4} alkyl), aryl (especially phenyl), heteroaryl (especially pyridinyl or pyrimidinyl), aralkyl (especially aryl(C_{1-4})alkyl, such as phenyl(C_{1-4}) alkyl), heteroarylalkyl (especially heteroaryl(C_{1-4})alkyl, such as pyridinyl(C_{1-4})alkyl or pyrimidinyl(C_{1-4})alkyl), alkenyl (especially C_{3-4} alkenyl), aralkenyl (especially aryl(C_{3-4})alkenyl, such as phenyl(C_{3-4})alkenyl), alkynyl (especially C_{3-4} alkynyl), alkoxycarbonyl (especially C_{1-4} alkoxycarbonyl), alkanesulfonyl (especially C_{1-4} alkylsulfonyl), arenesulfonyl (especially phenylsulfonyl), alkenyloxycarbonyl (especially C_{3-4} alkenyl-oxycarbonyl), aralkyloxycarbonyl (especially phenyl(C_{1-4})alkoxycarbonyl), aryloxycarbonyl (especially phenoxycarbonyl), heterocyclylalkyl (especially heterocyclyl(C_{1-4})alkyl, such as piperidinyl(C_{1-4})alkyl), carbamyl ($H_2NC(O)$), dithiocarboxyl or $X'R^3$ (where X' represents oxygen or a group NR^4), provided that when R is alkenyl, aralkenyl or alkynyl said group does not have an unsaturated carbon atom bonding directly to the ring nitrogen of formula (I); R^3 and R^4 are, independently, hydrogen, alkyl (especially C_{1-4} alkyl), aryl (especially phenyl), heteroaryl (especially pyridinyl or pyrimidinyl), aralkyl (especially aryl(C_{1-4})alkyl, such as phenyl(C_{1-4})alkyl), heteroarylalkyl (especially heteroaryl(C_{1-4})alkyl, such as pyridinyl(C_{1-4})alkyl or pyrimidinyl(C_{1-4})alkyl), alkenyl (especially C_{2-4} alkenyl), aralkenyl (especially aryl(C_{2-4})alkenyl, such as phenyl(C_{2-4})alkenyl), alkynyl (especially C_{2-4} alkynyl), heterocyclylalkyl (especially heterocyclyl(C_{1-4})alkyl, such as piperidinyl(C_{1-4})alkyl), alkoxycarbonyl (especially C_{1-4} alkoxycarbonyl) or carboxylic acyl (especially C_{1-4} alkyl-carbonyloxy); alkyl moieties of R, R^3 and R^4 comprise from 1 to 15 carbon atoms, and are optionally substituted with one or more substituents selected from halogen, cyano, carboxyl (HOC(O)), carboxylic acyl (especially C_{1-4} alkylcarbonyloxy), carbamyl ($H_2NC(O)$), alkoxycarbonyl (especially C_{1-4} alkoxycarbonyl), alkoxy (especially C_{1-4} alkoxy), alkylenedioxy (especially C_{1-4} alkylenedioxy), hydroxy, nitro, amino, acylamino (especially C_{1-4} alkyl-carbonylamino), imidate (C_{1-4} alkyl[C(O)NHC(O)]) and phosphonato ($OP(OH)_2$) groups; aryl, heteroaryl,

aralkyl, heteroarylalkyl, alkenyl, aralkenyl, alkynyl, alkoxycarbonyl, alkanesulfonyl, arenesulfonyl, alkenyloxycarbonyl, aralkyloxycarbonyl, aryloxycarbonyl, heterocyclylalkyl, carbamyl, dithiocarboxyl moieties of R, R^3 and R^4 comprise from 1 to 15 carbon atoms, and are optionally substituted with one or more substituents selected from, halogen, cyano, carboxyl (HOC(O)), carboxylic acyl (especially C_{1-4} alkylcarbonyloxy), carbamyl ($H_2NC(O)$), alkoxycarbonyl (especially C_{1-4} alkoxycarbonyl), alkoxy (especially C_{1-4} alkoxy), alkylenedioxy (especially C_{1-4} alkylenedioxy), hydroxy, nitro, haloalkyl (especially C_{1-4} haloalkyl), alkyl (especially C_{1-4} alkyl), amino, acylamino (especially C_{1-4} alkylcarbonyl-amino), imidate (C_{1-4} alkyl[C(O)NHC(O)]) and phosphonato ($OP(OH)_2$) groups; or an acid addition salt, quaternary ammonium salt or N-oxide derived therefrom; or an effective amount of a composition comprising an effective amount of a compound of formula (I), as hereinbefore defined, and an insecticidally, acaricidally or nematocidally acceptable carrier or diluent therefor.

The invention provides a method of combating and controlling insect, acarine or nematode pests which comprises treating said pests, or the locus of said pests, with an effective amount of a compound of formula (Ia) or (Ib):



(Ia)



(Ib)

wherein; Ar represents an optionally substituted phenyl or 5-or 6-membered heterocyclic ring system containing from 1 to 3 heteroatoms individually selected from nitrogen, oxygen and sulfur atoms, and at least one unsaturation (double bond) between adjacent atoms in the ring, wherein the substutuents, if present, are selected from halogen atoms, alkyl, alkenyl, alkynyl, alkoxy, haloalkyl, haloalkenyl, alkylthio and alkyl amino groups, any of which groups contain up to six carbon, wherein R represents hydrogen or cyano or a group selected from alkyl, aryl, heteroaryl, aralkyl, heteroarylalkyl, alkenyl, aralkenyl, alkynyl, alkoxycarbonyl, alkanesulfonyl, arenesulfonyl, alkanyloxycarbonyl, aralkyloxycarbonyl, aryloxycarbonyl, heterocyclylalkyl, carbamyl or dithiocarboxyl groups, said groups comprising from 1 to 15 carbon atoms, said groups being optionally substituted with one or more substituents selected

from, halogen, cyano, carboxyl, carboxylic acyl, carbamyl, alkoxycarbonyl, alkoxy, alkylenedioxy, hydroxy, nitro, haloalkyl, alkyl, amino, acylamino, imidate and phosphonato groups; and W, X, Y and Z are selected from hydrogen, hydroxy, acyloxy, alkoxy, alkylsilyloxy and halogen; and acid addition salts and quaternary ammonium salts and N-oxides derived therefrom; or an effective amount of a composition comprising a compound of formula (I), as hereinbefore defined, and an insecticidally, acaricidally or nematocidally acceptable carrier or diluent therefor.

In another aspect the present invention provides a method as hereinbefore described wherein A is CH_2CH_2.

In a further aspect the present invention provides a method as hereinbefore described wherein Ar is phenyl, pyridinyl, pyridazinyl or pyrazinyl, all being optionally substituted with halogen (especially fluorine, chlorine or bromine), C_{1-4} alkyl (especially methyl), C_{1-4} alkoxy (especially methoxy), C_{2-4} alkenyl, C_{2-4} alkynyl or cyano.

In a still further aspect the present invention provides a method as hereinbefore described wherein R is hydrogen, $CO_2(C_{1-4}$ alkyl) (such as CO_2CH_3), C_{1-4} alkyl (optionally substituted with cyano, $CO_2(C_{1-4}$ alkyl) or phenyl (itself optionally substituted with halogen, C_{1-4} alkyl, C_{1-4} alkoxy, C_{1-4} haloalkyl or C_{1-4} haloalkoxy)), or CH_2R^1, and R^1 is C_{1-4} haloalkyl (such as CF_3 or CHF_2), C_{2-4} alkenyl (such as $CH=CH_2$) or C_{2-4} alkynyl (such as $C\equiv CH$, $CH_2C\equiv CCH_3$ or $CH_2C\equiv CH$).

In another aspect the present invention provides a method as hereinbefore described wherein Ar is pyridyl (especially pyrin-3-yl) optionally substituted with halogen (especially chlorine or bromine). Ar is, for example, 5-chloropyrid-3-yl, 6-chloropyrid-3-yl, 5,6-dichloropyrid-3-yl, 5-bromopyrid-3-yl, 6-bromopyrid-3-yl or 5,6-dibromopyrid-3-yl.

In yet another aspect the present invention provides a method as hereinbefore described wherein R is CH_2R^1, andR^1 is C_{1-4} haloalkyl (such as CF_3 or CHF_2), C_{2-4} alkenyl (such as $CH=CH_2$) or C_{2-4} alkynyl (such as $C\equiv CH$, $CH_2C\equiv CCH_3$ or $CH_2C\equiv CH$).

In a still further aspect the present invention provides an insecticidal, acaricidal or nematicidal composition comprising an effective amount of a compound of formula (I) as hereinbefore defined, and an insecticidally, acaricidally or nematicidally acceptable carrier or diluent therefor.

In another aspect the present invention provides a compound of formula (I), wherein A is WXC-CYZ or XC=CY; Ar is pyridyl optionally substituted with halogen; R is

hydrogen, C_{1-4} alkyl (optionally substituted with cyano, $CO_2(C_{1-4}$ alkyl) or phenyl (itself optionally substituted with halogen, C_{1-4} alkyl, C_{1-4} alkoxy, C_{1-4} haloalkyl or C_{1-4} haloalkoxy)), or CH_2R^1, and R^1 is C_{1-4} haloalkyl (such as CF_3 or CHF_2), C_{2-4} alkenyl (such as $CH=CH_2$) or C_{2-4} alkynyl (such as $C\equiv CH$, $CH_2C\equiv CCH_3$ or $CH_2C\equiv CH$); W, X, Y and Z are, independently, hydrogen, hydroxy, acyloxy, alkoxy, alkylsilyloxy, cyano or halogen; or an acid addition salt, quaternary ammonium salt or N-oxide derived therefrom.

In a further aspect the present invention provides a compound of formula (I), wherein A is CH_2CH_2; and Ar is pyridyl (especially pyrid-3-yl) optionally substituted with halogen (especially chlorine or bromine).

In a still further aspect the present invention provides a compound of formula (I), wherein R is hydrogen, C_{1-4} alkyl or CH_2R^1, and R^1 is C_{1-4} haloalkyl (such as CF_3 or CHF_2), C_{2-4} alkenyl (such as $CH=CH_2$) or C_{2-4} alkynyl (such as $C\equiv CH$, $CH_2C\equiv CCH_3$ or $CH_2C\equiv CH$). It is preferred that R is CH_2R^1 wherein R^1 is C_{1-4} haloalkyl (such as CF_3 or CHF_2).

Specific compounds of formula (I) are set out in Table I.

TABLE I

Compound No.	Ar	R
1	6-chloropyrid-3-yl	methyl
2	pyrid-3-yl	methyl
3	5-bromopyridyl	CH_2CF_3
4	6-chloropyrid-3-yl	CH_2CF_3
5	6-chloropyrid-3-yl	CH_2CHF_2
6	5-bromopyridyl	methyl
7	5-bromopyridyl	CH_2CHF_2
8	pyrid-3-yl	CH_2CF_3
9	pyrid-3-yl	CH_2CF_3
10	5-chloropyrid-3-yl	CH_2CF_3
11	5-chloropyrid-3-yl	CH_2CHF_2
12	5-chloropyrid-3-yl	methyl
13	5,6-dichloropyrid-3-yl	CH_2CF_3
14	5,6-dichloropyrid-3-yl	CH_2CHF_2
15	5,6-dichloropyrid-3-yl	methyl
16	5,6-dichloropyrid-3-yl	H

17	5-chloropyrid-3-yl	H
18	6-chloropyrid-3-yl	H
19	5-bromopyridyl	H
20	pyrid-3-yl	H
21	5-chloropyrid-3-yl	CHO
22	6-chloropyrid-3-yl	CHO
23	5-bromopyridyl	CHO
24	pyrid-3-yl	CHO
25	5-chloropyrid-3-yl	CO_2CH_3
26	6-chloropyrid-3-yl	CO_2CH_3
27	5-bromopyridyl	CO_2CH_3
28	pyrid-3-yl	CO_2CH_3
29	5-chloropyrid-3-yl	$CH_2CH=CH_2$
30	6-chloropyrid-3-yl	$CH_2CH=CH_2$
31	5-bromopyridyl	$CH_2CH=CH_2$
32	pyrid-3-yl	$CH_2CH=CH_2$
33	5-chloropyrid-3-yl	$CH_2C\equiv CH$
34	6-chloropyrid-3-yl	$CH_2C\equiv CH$
35	5-bromopyridyl	$CH_2C\equiv CH$
36	pyrid-3-yl	$CH_2C\equiv CH$
37	5-chloropyrid-3-yl	$CH_2C\equiv CCH_3$
38	6-chloropyrid-3-yl	$CH_2C\equiv CCH_3$
39	5-bromopyridyl	$CH_2C\equiv CCH_3$
40	pyrid-3-yl	$CH_2C\equiv CCH_3$
41	5-chloropyrid-3-yl	$CH_2CO_2CH_3$
42	6-chloropyrid-3-yl	$CH_2CO_2CH_3$
43	5-bromopyridyl	$CH_2CO_2CH_3$
44	pyrid-3-yl	$CH_2CO_2CH_3$

The preparation of the compounds of formula (I) may be accomplished by adaptation of methods described in the literature, by use of one or more of the following synthetic

techniques described below and further illustrated in the Examples, or by combining literature methods with those methods described below.

A compound of formula (I) can be prepared by dehydrating a compound of formula (II) under suitable conditions (for example diethylamino sulfurtrifluoride at a temperature in the range -30-40°C, or heating with an acid (such as p-toluenesulfonic acid)).

A compound of formula (II) can be prepared by reacting a compound ArHal, wherein Hal is a halogen, with a suitable base (such as n-butyl lithium) and reacting the product so formed with a compound of formula (III). (See WO96/37494 for preparation of compounds of formula (III)).

Compounds of formula (I) wherein A is CH=CH can be prepared by heating a compound of fomula (I) wherein A is CH_2CHZ (wherein Z is a suitable group, such as a thiono-4-tolyloxy group) in a suitable solvent (such as xylene) at a suitable temperature (such as reflux).

Compounds of formula (I) wherein A is CH_2CHZ (wherein Z is a suitable group, such as a thiono-4-tolyloxy group) can be prepared by treating compounds of formula (I) wherein A is $CH_2CH(OH)$ with a suitable chloroformate (such as 4-tolyl chlorothionoformate) in the presence of a suitable base (such as N,N-dimethylaminopyridine).

Alternatively a compound of formula (I) wherein A is CH=CH can be prepared by dehydrating a compound of formula (I) wherein A is $CH_2CH(OH)$ with a suitable dehydrating agent, such as diethylaminosulfurtrifluoride.

A compound of formula (I) wherein A is CH_2CHF can be prepared by fluorinating a compound of formula (I) wherein A is $CH_2CH(OH)$ with, for example, a mixture of hydrogen fluoride and sulfur trifluoride.

A compound of formula (I) wherein A is $CH_2C(=O)$ can be prepared by oxidising a compound of formula (I) wherein A is $CH_2CH(OH)$ with an oxidant under suitable conditions [for example an acid chloride (such as oxalyl chloride) and dimethylsulfoxide at a suitable temperature (such as below -50°C) in the presence of a suitable base (such as triethylamine)].

A compound of formula (I) wherein A is CH_2CF_2 can be prepared by fluorinating a compound of formula (I) wherein A is $CH_2C(=O)$ with, for example, diethylaminosulfur trifluoride.

A compound of formula (I) wherein A is CH=CH can be prepared by reacting a compound of formula (I) wherein A is $CH_2CH(OZ')$, wherein Z' is a suitable group (such as SO_2CH_3) with a suitable amine (such as 1,8-diazabicyclo[5.4.0]undec-7-ene).

A compound of formula (I) wherein A is $CH_2CH(OZ')$, wherein Z' is a suitable group (such as SO_2CH_3) can be prepared by reacting a compound of formula (I) wherein A is $CH_2CH(OH)$ with a suitable acid chloride (such as mesyl chloride).

In further aspects the present invention provides processes for preparing compounds of formula (I), as hereinbefore described, and the intermediate compounds of formula (II).

The compounds of formula (I) [or an acid addition salt, quaternary ammonium salt or N-oxide of a compound of formula (I)] can be used to combat and control infestations of insect pests such as Lepidoptera, Diptera, Homoptera and Coleoptera (including Diabrotica i.e. corn rootworms) and also other invertebrate pests, for example, acarine pests. The insect and acarine pests which may be combated and controlled by the use of the compounds of formula (I) include those pests associated with agriculture (which term includes the growing of crops for food and fibre products), horticulture and animal husbandry, forestry, the storage of products of vegetable origin, such as fruit, grain and timber, and also those pests associated with the transmission of diseases of man and animals. Examples of insect and acarine pest species which may be controlled by the compounds of formula (I) include: Myzus persicae (aphid), Aphis gossypii (aphid), Aphis fabae (aphid), Aedes aegypti (mosquito), Anopheles spp. (mosquitos), Culex spp. (mosquitos), Dysdercus fasciatus (capsid), Musca domestica (housefly), Pieris brassicae (white butterfly), Plutella xylostella (diamond back moth), Phaedon cochleariae (mustard beetle), Aonidiella spp. (scale insects), Trialeurodes spp. (white flies), Bemisia tabaci (white fly), Blattella germanica (cockroach), Periplaneta americana (cockroach), Blatta orientalis (cockroach), Spodoptera littoralis (cotton leafworm), Heliothis virescens (tobacco budworm), Chortiocetes terminifera (locust), Diabrotica spp. (rootworms), Agrotis spp. (cutworms), Chilo partellus (maize stem borer), Nilaparvata lugens (planthopper), Nephotettix cincticeps (leafhopper), Panonychus ulmi (European red mite), Panonychus citri (citrus red mite), Tetranychus urticae (two-spotted spider mite), Tetranychus cinnabarinus (carmine spider mite), Phyllcoptruta oleivora (citrus rust mite), Polyphagotarsonemus latus (broad mite) and Brevipalpus spp. (mites). Further examples include insects which adversely affect the health of the public or of animals.

In order to apply the compounds of formula (I) to the locus of the nematode, insect or acarid pest, or to a plant susceptible to attack by the nematode, insect or acarid pest, the compound is usually formulated into a composition which includes in addition to a compound of formula (I) a suitable inert diluent or carrier material, and, optionally, a surface active agent. The amount of composition generally applied for the control of nematode pests gives a rate of active ingredient from 0.01 to 10 kg per hectare, preferably from 0.1 to 6 kg per hectare.

The compositions can be applied to the soil, plant or seed, to the locus of the pests, or to the habitat of the pests, in the form of dusting powders, wettable powders, granules (slow or fast release), emulsifiable concentrates, suspension concentrates, liquid solutions, emulsions, seed dressings, fogging/smoke formulations or controlled release compositions, such as microencapsulated granules or suspensions.

Dusting powders are formulated by mixing the active ingredient with one or more finely divided solid carriers and/or diluents, for example natural clays, kaolin, pyrophyllite, bentonite, alumina, montmorillonite, kieselguhr, chalk, diatomaceous earths, calcium phosphates, calcium and magnesium carbonates, sulphur, lime, flours, talc and other organic and inorganic solid carriers.

Granules are formed either by absorbing the active ingredient in a porous granular material for example pumice, attapulgite clays, fuller's earth, kieselguhr, diatomaceous earths, ground corn cobs, and the like, or by adsorbing the active ingredient on to hard core materials such as sands, silicates, mineral carbonates, sulphates, phosphates, or the like. Agents which are commonly used to aid absorption or adsorption include aliphatic and aromatic petroleum solvents, alcohols, polyvinyl acetates, polyvinyl alcohols, ethers, ketones, esters, dextrins, sugars and vegetable oils. Other additives may also be included in granules, such as emulsifying agents, wetting agents or dispersing agents.

Microencapsulated formulations (microcapsule suspensions CS) or other controlled release formulations may also be used, particularly for slow release over a period of time and for seed treatment.

Alternatively the compositions may be in the form of liquid preparations to be used as dips, irrigation additives or sprays, which are generally aqueous dispersions or emulsions of the active ingredient in the presence of one or more known wetting agents, dispersing agents or emulsifying agents (surface active agents). The compositions which are to be used in the

form of aqueous dispersions or emulsions are generally supplied in the form of an emulsifiable concentrate (EC) or a suspension concentrate (SC) containing a high proportion of the active ingredient or ingredients. An EC is a homogeneous liquid composition, usually containing the active ingredient dissolved in a substantially non-volatile organic solvent. An SC is a fine particle size dispersion of solid active ingredient in water. In use, the concentrates are diluted in water and applied by means of a spray to the area to be treated.

Suitable liquid solvents for ECs include methyl ketones, methyl isobutyl ketone, cyclohexanone, xylenes, toluene, chlorobenzene, paraffins, kerosene, white oil, alcohols, (for example, butanol), methylnaphthalene, trimethylbenzene, trichloroethylene, N-methyl-2-pyrrolidone and tetrahydrofurfuryl alcohol (THFA).

Wetting agents, dispersing agents and emulsifying agents may be of the cationic, anionic or non-ionic type. Suitable agents of the cationic type include, for example, quaternary ammonium compounds, for example cetyltrimethyl ammonium bromide. Suitable agents of the anionic type include, for example, soaps, salts of aliphatic monoesters of sulphuric acid, for example sodium lauryl sulphate, salts of sulphonated aromatic compounds, for example sodium dodecylbenzenesulphonate, sodium, calcium or ammonium lignosulphonate, or butylnaphthalene sulphonate, and a mixture of the sodium salts of diisopropyl- and triisopropylnaphthalene sulphonates. Suitable agents of the non-ionic type include, for example, the condensation products of ethylene oxide with fatty alcohols such as oleyl alcohol or cetyl alcohol, or with alkyl phenols such as octyl phenol, nonyl phenol and octyl cresol. Other non-ionic agents are the partial esters derived from long chain fatty acids and hexitol anhydrides, the condensation products of the said partial esters with ethylene oxide, and the lecithins.

These concentrates are often required to withstand storage for prolonged periods and after such storage, to be capable of dilution with water to form aqueous preparations which remain homogeneous for a sufficient time to enable them to be applied by conventional spray equipment. The concentrates may contain 10-85% by weight of the active ingredient or ingredients. When diluted to form aqueous preparations such preparations may contain varying amounts of the active ingredient depending upon the purpose for which they are to be used.

The compounds of formula (I) may also be formulated as powders (dry seed treatment DS or water dispersible powder WS) or liquids (flowable concentrate FS, liquid seed treatment LS, or microcapsule suspension CS) for use in seed treatments.

In use the compositions are applied to the insect pests, to the locus of the pests, to the habitat of the pests, or to growing plants liable to infestation by the pests, by any of the known means of applying pesticidal compositions, for example, by dusting, spraying or incorporation of granules.

The compound of formula (I) may be the sole active ingredient of the composition or it may be admixed with one or more additional active ingredients such as insecticides, synergists, herbicides, fungicides or plant growth regulators where appropriate. Suitable additional active ingredients for inclusion in admixture with a compound of formula (I) may be compounds which will broaden the spectrum of activity of the compositions of the invention or increase their persistence in the location of the pest. They may synergise the activity of the compound of formula (I) or complement the activity for example by increasing the speed of effect or overcoming repellency. Additionally multi-component mixtures of this type may help to overcome or prevent the development of resistance to individual components. The particular additional active ingredient included will depend upon the intended utility of the mixture and the type of complementary action required. Examples of suitable insecticides include the following:

a) Pyrethroids such as permethrin, esfenvalerate, deltamethrin, cyhalothrin in particular lambda-cyhalothrin, biphenthrin, fenpropathrin, cyfluthrin, tefluthrin, fish safe pyrethroids for example ethofenprox, natural pyrethrin, tetramethrin, s-bioallethrin, fenfluthrin, prallethrin and 5-benzyl-3-furylmethyl-(E)-(1R,3S)-2,2-dimethyl-3-(2-oxothiolan-3-ylidenemethyl) cyclopropane carboxylate;

b) Organophosphates such as profenofos, sulprofos, methyl parathion, azinphos-methyl, demeton-s-methyl, heptenophos, thiometon, fenamiphos, monocrotophos, profenophos, triazophos, methamidophos, dimethoate, phosphamidon, malathion, chloropyrifos, phosalone, terbufos, fensulfothion, fonofos, phorate, phoxim, pyrimiphos-methyl, pyrimiphos-ethyl, fenitrothion or diazinon;

c) Carbamates (including aryl carbamates) such as pirimicarb, cloethocarb, carbofuran, furathiocarb, ethiofencarb, aldicarb, thiofurox, carbosulfan, bendiocarb, fenobucarb, propoxur or oxamyl;

d) Benzoyl ureas such as triflumuron, or chlorfluazuron;

e) Organic tin compounds such as cyhexatin, fenbutatin oxide, azocyclotin;

f) Macrolides such as avermectins or milbemycins, for example such as abamectin, ivermectin, and milbemycin;

g) Hormones and pheromones;

h) Organochlorine compounds such as benzene hexachloride, DDT, chlordane or dieldrin;

i) Amidines, such as chlordimeform or amitraz;

j) Fumigant agents;

k) Imidacloprid;

l) Spinosad.

In addition to the major chemical classes of insecticide listed above, other insecticides having particular targets may be employed in the mixture if appropriate for the intended utility of the mixture. For instance selective insecticides for particular crops, for example stemborer specific insecticides for use in rice such as cartap or buprofezin can be employed. Alternatively insecticides specific for particular insect species/stages for example ovo-larvicides such as chlofentezine, flubenzimine, hexythiazox and tetradifon, motilicides such as dicofol or propargite, acaricides such as bromopropylate, chlorobenzilate, or growth regulators such as hydramethylron, cyromazine, methoprene, chlorofluazuron and diflubenzuron may also be included in the compositions.

Examples of suitable synergists for use in the compositions include piperonyl butoxide, sesamax, safroxan and dodecyl imidazole.

Suitable herbicides, fungicides and plant-growth regulators for inclusion in the compositions will depend upon the intended target and the effect required.

An example of a rice selective herbicide which can be included is propanil, an example of a plant growth regulator for use in cotton is "Pix", and examples of fungicides for use in rice include blasticides such as blasticidin-S. The ratio of the compound of formula (I) to the other active ingredient in the composition will depend upon a number of factors including type of target, effect required from the mixture etc. However in general, the additional active ingredient of the composition will be applied at about the rate at which it is usually employed, or at a slightly lower rate if synergism occurs.

The invention is illustrated by the following Examples. Examples 1-9 illustrate the preparation of compounds of formula (I). Examples 9-17 illustrate compositions suitable for

the application of the compounds of formula (I). The following ingredients are referred to by their Registered Trade Marks and have the composition as shown below.

Registered Trade Mark	Composition
Synperonic NP8 } Synperonic NP13 }	Nonylphenol-ethylene oxide condensate
Synperonic OP10	Octylphenol-ethylene oxide condensate
Aromasol H	Alkylbenzene solvent
Solvesso 200	Inert organic diluent
Keltrol	Polysaccharide

Selected NMR data and melting point data are presented in the Examples. For NMR data, no attempt has been made to list every absorption. The following abbreviations are used throughout the Examples:

mp = melting point (uncorrected)
ppm = parts per million
s = singlet
t = triplet
d = doublet
q = quartet
dd = double doublet
dt = double triplet
brdd = broad double doublet
brd = broad doublet
m = multiplet
brs = broad singlet

EXAMPLE 1

This Example illustrates the preparation of 8-tert-butyloxycarbonyl-8-azabicyclo[3.2.1]octan-3-one.

Iodotrimethylsilane (0.87ml, 6.09mmol) was added dropwise to a stirred solution of N-carboethoxytropinone in dry chloroform at 0°C under nitrogen. A precipitate was formed. The mixture was heated to reflux for 5hours then allowed to cool to room temperature. Methanolic hydrochloric acid (2.0ml, 5M) was added at 0°C and effervescence was observed. The mixture was stirred for 1.5hours and then evaporated under reduced pressure. The crude brown solid was azeotroped with toluene and dried under reduced pressure (high vacuum). To a suspension of this material in dry dichloromethane at 0°C under nitrogen was added pyridine (1.03ml, 12.7mmol) and 4-(N,N-dimethylamino)pyridine (catalytic). The mixture was stirred for 0.5hours until all the solid had dissolved. A solution of di-tert-

butyldicarbonate in dichloromethane was added dropwise and the mixture allowed to warm to room temperature for 1hour. Water was added and the layers separated. The aqueous layer was extracted with dichloromethane (three times) and the combined organic phases were washed with saturated copper sulfate solution, water, brine, then dried (magnesium sulfate) and evaporated under reduced pressure to give a brown oil. The oil was fractionated by chromatography (silica gel, 30% ethyl acetate in petroleum ether) to give 8-tert-butyloxycarbonyl-8-azabicyclo[3.2.1]-octan-3-one as a white solid 0.865g.

^{1}H NMR ($CDCl_3$): δ 1.50(9H,s), 1.70(2H,m), 2.10(2H,m), 2.35(2H,m), 2.70(2H,brs), 4.50(2H,brs)ppm.

Mass spectrum (EI): M^+ 225.

EXAMPLE 2

This Example illustrates the preparation of exo-3-(6-chloropyrid-3-yl)-endo-3-hydroxy-8-tert-butyl-oxycarbonyl-8-azabicyclo[3.2.1]octane.

n-Butyl lithium (5.92ml, 2.5M solution in hexane) was added dropwise to a stirred solution of 2-chloro-5-iodopyridine (3.54g, 14.8mmol) in dry diethyl ether (60ml) and dry tetrahydrofuran (30ml) at -78°C under nitrogen. The solution became yellow turning to orange and an orange precipitate was formed. After stirring at this temperature for 0.5hour a solution of 8-tert-butyloxycarbonyl-8-azabicyclo[3.2.1]octan-3-one (2.56g, 11.4mmol) in dry diethyl ether was added dropwise. The mixture was allowed to warm over 15hours. Saturated ammonium chloride was added and the layers separated. The aqueous layer was further extracted with ethyl acetate (three times) and the combined organic layers washed with brine, dried (magnesium sulfate) and evaporated under reduced pressure to give a brown oil. The oil was fractionated by chromatography (silica gel, 25% ethyl acetate in petroleum ether) to give exo-3-(6-chloropyrid-3-yl)-endo-3-hydroxy-8-tert-butyloxycarbonyl-8-azabicyclo[3.2.1]octane as a yellow foam 2.45g.

^{1}H NMR ($CDCl_3$): δ 1.49(9H,s), 1.86(2H,m), 2.00(2H,m), 2.15(1H,s), 2.25(3H,m), 2.40(1H,m), 4.30(2H,brd), 7.27(1H,d), 7.65(1H,dd), 8.4(1H,d)ppm.

Mass spectrum (EI): M^+ 338.

EXAMPLE 3

This Example illustrates the preparation of exo-3-(6-chloropyrid-3-yl)-endo-3-hydroxy-8-methyl-8-azabicyclo[3.2.1]octane.

exo-3-(6-Chloropyrid-3-yl)-endo-3-hydroxy-8-tert-butyloxycarbonyl-8-azabicyclo [3.2.1]octane (0.30g, 0.89mmol) was dissolved in formic acid (4ml) and heated to reflux for 1hour. Paraformaldehyde (0.30g) was added and refluxing continued for 3hours. The excess formic acid was removed by evaporation under reduced pressure and the residue was partitioned between dichloromethane and dilute sodium hydroxide. The layers were separated and the aqueous layer further extracted with dichloromethane (three times). The combined organic phases were washed with brine, then dried (magnesium sulfate), and evaporated under reduced pressure to give exo-3-(6-chloropyrid-3-yl)-endo-3-hydroxy-8-methyl-8-azabicyclo[3.2.1]octane as a light brown solid, 0.126g.

^{1}H NMR ($CDCl_3$): δ 1.80(1H,m), 1.82(2H,d), 2.10(2H,m), 2.25(2H,m), 2.35(1H,m), 2.35(3H,s), 3.30(2H,s), 7.27(1H,d), 7.82(1H,dd), 8.55(1H,d)ppm.

Mass spectrum (EI): M^+ 252.

EXAMPLE 4

This Example illustrates the preparation of 3-(6-chloropyrid-3-yl)-8-methyl-8-azabicyclo[3.2.1]oct-2-ene (Compound No.1, Table I).

To a stirred solution of exo-3-(6-chloropyrid-3-yl)-endo-3-hydroxy-8-methyl-8-azabicyclo[3.2.1]octane (0.12g, 0.475mmol) in dichloromethane and dimethoxyethane (50/50) (10ml), at -10°C under an atmosphere of nitrogen, was added dropwise a solution of diethylaminosulfur trifluoride (0.075ml, 0.570mmol) in dichloromethane (2ml).[1] The mixture was stirred at this temperature for 10minutes then allowed to warm to room temperature for 15hours. The mixture was poured into water and the aqueous layer extracted with dichloromethane (three times). The combined organic phases were washed with brine, dried (magnesium sulfate), and evaporated under reduced pressure to give a brown oil. The oil was fractionated by chromatography (silica gel, 20% methanol in dichloromethane) to give 3-(6-chloropyrid-3-yl)-8-methyl-8-azabicyclo[3.2.1]oct-2-ene as a brown foam, 0.058g.

^{1}H NMR ($CDCl_3$): δ 2.00(1H,m), 2.30(1H,m), 2.70(4H,m), 2.9(3H,s), 4.15(1H,m), 4.25(1H,m), 6.39(1H,d), 7.35(1H,d), 7.70(1H,dd), 8.43(1H,d)ppm

Mass spectrum (EI): M^+ 234.

EXAMPLE 5

This Example illustrates the preparation of exo-3-(pyrid-3-yl)-endo-3-hydroxy-8-tert-butyloxycarbonyl-8-azabicyclo[3.2.1]octane.

To a solution of exo-3-(2-chloropyrid-3-yl)-endo-3-hydroxy-8-tert-butyloxycarbonyl-8-azabicyclo[3.2.1]octane (0.40g) in methanol (8ml) was added potassium hydroxide (0.089g) and palladium on carbon (5%, 0.40g). The mixture was stirred under an atmosphere of hydrogen (balloon) for 2hours, filtered through CELITE™ and evaporated under reduced pressure. The residue was partitioned between ethyl acetate and water and the layers separated. The aqueous layer was further extracted with ethyl acetate (twice) and the combined organic phases were washed with brine, dried (magnesium sulfate) and evaporated under reduced pressure to give exo-3-(pyrid-3-yl)-endo-3-hydroxy-8-tert-butyloxycarbonyl-8-azabicyclo[3.2.1]octane as a white foam 0.356g.

^{1}H NMR ($CDCl_3$): δ 1.5(9H,s), 1.85(2H,m), 2.0(2H,m), 2.2-2.5(4H,m), 2.95(1H,brs), 4.3(2H,brd), 7.25(1H,dd), 7.7(1H,dt), 8.4(1H,dd), 8.65(1H,d)ppm.

EXAMPLE 6

This Example illustrates the preparation of exo-3-(pyrid-3-yl)-endo-3-hydroxy-8-methyl-8-azabicyclo[3.2.1]octane

exo-3-(Pyrid-3-yl)-endo-3-hydroxy-8-tert-butyloxycarbonyl-8-azabicyclo[3.2.1]-octane (0.35g, 1.15mmol) was dissolved in formic acid (10ml) and heated to reflux for 1hours. Paraformaldehyde (0.35g) was added and refluxing continued for 2hours. The excess formic acid was removed by evaporation under reduced pressure and the residue was partitioned between dichloromethane and dilute sodium hydroxide. The layers were separated and the aqueous layer further extracted with dichloromethane (three times). The combined organic phases were washed with brine, then dried (magnesium sulfate), and evaporated under reduced pressure to give a yellow oil. Recrystallisation (dichloromethane and hexane) gave exo-3-(pyrid-3-yl)-endo-3-hydroxy-8-methyl-8-azabicyclo[3.2.1]octane as a white solid 0.133g.

^{1}H NMR ($CDCl_3$): δ 1.85(2H,d), 2.1(2H,m), 2.3(2H,m), 2.35-2.45(3H,m), 2.40(3H,s), 3.30(2H,s), 7.25(1H,dd), 7.85(1H,d), 8.42(1H,dd), 8.76(1H,d)ppm.

Mass spectrum (EI): M^+ 218.

EXAMPLE 7

This Example illustrates the preparation of 3-(pyrid-3-yl)-8-methyl-8-azabicyclo[3.2.1]oct-2-ene (Compound No. 2, Table I).

To a stirred solution of exo-3-(pyrid-3-yl)-endo-3-hydroxy-8-methyl-8-azabicyclo-[3.2.1]octane (0.076g, 0.348mmol) in dichloromethane and dimethoxyethane (50/50; 5ml), at

-10°C under an atmosphere of nitrogen, was added dropwise a solution of diethylaminosulfur trifluoride (0.055ml, 0.42mmol) in dichloromethane (2ml). The mixture was stirred at this temperature for 10minutes then allowed to warm to room temperature for 12hours. The mixture was poured into water and the aqueous layer extracted with dichloromethane (three times). The aqueous layer was evaporated under reduced pressure and the residue dissolved in dilute sodium hydroxide (2N). This was extracted with dichloromethane (three times) and the combined organic phases were washed with brine, dried (magnesium sulfate), and evaporated under reduced pressure to give a brown oil. The oil was fractionated by chromatography (silica gel, 20% methanol in dichloromethane) to give 3-(pyrid-3-yl)-8-methyl-8-azabicyclo[3.2.1]oct-2-ene, 0.041g, as a yellow oil.

^{1}H NMR ($CDCl_3$): δ 1.65(1H,m), 1.95(1H,m), 2.05-2.3(3H,m), 2.43(3H,s), 2.90(1H,brdd), 3.50(2H,m), 6.34(1H,d), 7.23(1H,dd), 7.65(1H,dt), 8.47(1H,dd), 8.65(1H,d)ppm.

Mass spectrum (EI): M^+ 200.

EXAMPLE 8

This Example illustrates the preparation of exo-3-(5-bromopyrid-3-yl)-endo-3-hydroxy-8-(2,2,2-trifluoroethyl)-8-azabicyclo[3.2.1]octane.

3,5-Dibromopyridine (5.15g) was dissolved in dry diethyl ether (40ml) and cooled to -78°C with stirring under an atmosphere of nitrogen. A solution of n-butyl lithium (8.35ml of a solution in hexane, 2.5M) was added dropwise maintaining the reaction below -65°C. The mixture was stirred at -78°C for 1hour then 8-(2,2,2-trifluoroethyl)-8-azabicyclo[3.2.1]-octan-3-one (see WO96/37494 for preparation, 2.0g) in dry tetrahydrofuran (15ml) was added dropwise. The reaction was stirred at -60°C for 2hours then quenched with a saturated, aqueous solution of ammonium chloride. The mixture was filtered , the filtrate extracted with diethyl ether (three times) then the extracts were combined, dried (magnesium sulfate) and evaporated under reduced pressure to give a yellow solid. The solid was fractionated by chromatography (silica; 15-25% ethyl acetate in hexane) to give the required product,1.8g, as a colourless solid, mp 148.5-150.5°C.

^{1}H NMR $CDCl_3$: δ 1.80-2.00(4H,m); 2.20-2.40(4H,m); 2.80-3.00(2H,q); 3.40(2H,m); 7.95(1H,t); 8.45-8.75(2H,m)ppm.

EXAMPLE 9

This Example illustrates the preparation of 3-(5-bromopyrid-3-yl)-8-(2,2,2-trifluoroethyl)-8-azabicyclo[3.2.1]oct-2-ene (Compound No. 3 Table I).

exo-3-(5-Bromopyrid-3-yl)-endo-3-hydroxy-8-(2,2,2-trifluoroethyl)-8-azabicyclo[3.2.1]octane (1.0g) was dissolved in dry dichloromethane (10ml) with stirring and cooled to 0°C under an atmosphere of nitrogen. Triethylamine (dry, 0.76ml) was added followed by methane sulfonylchloride (0.42ml). The mixture was stirred at 0°C for 1hour, allowed to warm to ambient temperature then was stirred for a further 4hours. The mixture was stored at ambient temperature for 18hours then further triethylamine (dry, 0.76ml) followed by methane sulfonylchloride (0.42ml) was added at room temperature. The mixture was stirred for 4hours at ambient temperature then stored for 2days. The mixture was poured into water and extracted with diethyl ether (three times). The extracts were combined, dried (magnesium sulfate) and evaporated under reduced pressure to give an orange gum. The gum was fractionated by chromatography (silica;10-20% ethyl acetate in hexane) to give the required product, 0.48g, as a pale yellow oil.

^{1}H NMR $CDCl_3$: δ 1.65(1H,m); 1.80-2.30(4H,m); 2.85(1H,m); 3.15(2H,q); 3.65(2H,m); 6.40(1H,m); 7.80(1H,t); 8.55(2H,m)ppm. Molecular ion 346.

EXAMPLE 10

This Example illustrates an emulsifiable concentrate composition which is readily convertible by dilution with water into a liquid preparation suitable for spraying purposes. The concentrate has the following composition:

	% Weight
Compound No. 1	25.5
SYNPERONIC NP13	2.5
Calcium dodecylbenzenenesulphonate	2.5
AROMASOL H	70

EXAMPLE 11

This Example illustrates a wettable powder composition which is readily convertible by dilution with water into a liquid preparation suitable for spraying purposes. The wettable powder has the following composition:

	% Weight
Compound No. 1	25.0
Silica	25.0
Sodium lignosulphonate	5.0
Sodium lauryl sulphate	2.0
Kaolinite	43.0

EXAMPLE 12

This Example illustrates a dusting powder which may be applied directly to plants or other surfaces and comprises 1% by weight of Compound No. 1 and 99% by weight of talc.

EXAMPLE 13

This Example illustrates a concentrated liquid formulation suitable for application by ultra low volume techniques after mixing with paraffinic diluents.

	% Weight
Compound No. 1	90.0
SOLVESSO 200	10.0

EXAMPLE 14

This Example illustrates a capsule suspension concentrate which is readily convertible by dilution with water to form a preparation suitable for application as an aqueous spray.

	% Weight
Compound No. 1	10.0
Alkylbenzene solvent (e.g. AROMASOL H)	5.0
Toluene di-isocyanate	3.0
Ethylenediamine	2.0
Polyvinyl alcohol	2.0
Bentonite	1.5
Polysaccharide (e.g. KELTROL)	0.1
Water	76.4

EXAMPLE 15

A ready for use granular formulation:

	% Weight
Compound No. 1	0.5
SOLVESSO 200	0.2
Nonylphenol ethoxylate (eg Synperonic NP8)	0.1
Calcium carbonate granules (0.3-0.7 mm)	99.2

EXAMPLE 16

An aqueous suspension concentrate:

	% Weight
Compound No. 1	5.0
Kaolinite	15.0
Sodium lignosulphonate	3.0
Nonylphenolethoxylate (eg Synperonic NP8)	1.5
Propylene glycol	10.0
Bentonite	2.0
Polysaccharide (eg Keltrol)	0.1
Bactericide (eg Proxel; Proxel is a registered Trade Mark)	0.1
Water	63.3

EXAMPLE 17

This Example illustrates a water dispersible granule formulation.

	% Weight
Compound No. 1	5
Silica	5
Sodium lignosulphate	10
Sodium dioctylsulphosuccinate	5
Sodium acetate	10
Montmorillonite powder	65

EXAMPLE 18

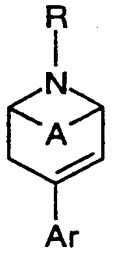
This Example illustrates the insecticidal properties of the compounds of formula (I). The activity of the compounds of formula (I) was determined using a variety of pests. The pests were treated with a liquid composition containing 500 parts per million (ppm) by weight of the compound unless otherwise stated. The compositions were made by dissolving the compound in acetone and ethanol (50:50) mixture and diluting the solutions with water containing 0.05% by weight of a wetting agent sold under the trade name "SYNPERONIC" NP8 until the liquid composition contained the required concentration of the compound. "SYNPERONIC" is a Registered Trade Mark.

The test procedure adopted with regard to each pest was basically the same and comprised supporting a number of the pests on a medium which was usually a substrate, a host plant or a foodstuff on which the pests feed, and treating either or both the medium and the pests with the compositions. The mortality of the pests was then assessed at periods usually varying from two to five days after the treatment.

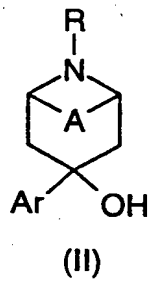
The results of the tests against peach aphid (Myzus persicae) are presented below. The results indicate a grading of mortality (score) designated as A, B or C wherein C indicates less than 40% mortality, B indicates 40-79% mortality and A indicates 80-100% mortality; "-" indicates that either the compound was not tested or no meaningful result was obtained. In this test Chinese cabbage leaves were infested with aphids, the infested leaves were sprayed with the test composition, and the mortality assessed after 3 days. Compound Nos. 1, 2 and 3 of Table I gave a mortality score of A.

In addition, in a similar test against red spider mites (Tetranychus urticae) Compound No. 3 of Table I gave a mortality score of A.

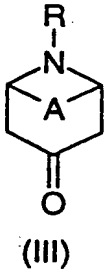
The formulae referred to hereinabove are presented below.



(I)



(II)



(III)

CLAIMS

1. A method of combating and controlling insect, acarine or nematode pests which comprises treating said pests, or the locus of said pests, with an effective amount of a compound of formula (I):

(I)

wherein A is WXC-CYZ or XC=CY; R is hydrogen, formyl or cyano or a group selected from alkyl, aryl, heteroaryl, aralkyl, heteroarylalkyl, alkenyl, aralkenyl, alkynyl, alkoxycarbonyl, alkanesulfonyl, arenesulfonyl, alkenyloxycarbonyl, aralkyloxycarbonyl, aryloxycarbonyl, heterocyclylalkyl, carbamyl, dithiocarboxyl or $X'R^3$ (where X' represents oxygen or a group NR^4), provided that when R is alkenyl, aralkenyl or alkynyl said group does not have an unsaturated carbon atom bonding directly to the ring nitrogen of formula (I); Ar is optionally substituted phenyl or an optionally substituted 5-or 6-membered heterocyclic ring system containing from 1 to 3 heteroatoms individually selected from nitrogen, oxygen and sulfur atoms, and at least one unsaturation (double bond) between adjacent atoms in the ring, said heterocyclic ring being optionally fused to a benzene ring, wherein the substutuents, if present, are selected from halogen atoms, cyano, alkyl, alkenyl, alkynyl, alkoxy, haloalkyl, haloalkenyl, alkylthio and alkyl amino groups, any of which groups contain up to six carbon atoms; W, X, Y and Z are, independently, hydrogen, hydroxy, acyloxy, alkoxy, alkylsilyloxy, cyano or halogen; alkyl moieties of R, R^3 and R^4 comprise from 1 to 15 carbon atoms, and are optionally substituted with one or more substituents selected from, halogen, cyano, carboxyl, carboxylic acyl, carbamyl, alkoxycarbonyl, alkoxy, alkylenedioxy, hydroxy, nitro, amino, acylamino, imidate and phosphonato groups; aryl, heteroaryl, aralkyl, heteroarylalkyl, alkenyl, aralkenyl, alkynyl, alkoxycarbonyl, alkanesulfonyl, arenesulfonyl, alkanyloxycarbonyl, aralkyloxycarbonyl, aryloxycarbonyl, heterocyclylalkyl, carbamyl, dithiocarboxyl moieties of R, R^3 and R^4 comprise from 1 to 15 carbon atoms, and are optionally

substituted with one or more substituents selected from, halogen, cyano, carboxyl, carboxylic acyl, carbamyl, alkoxycarbonyl, alkoxy, alkylenedioxy, hydroxy, nitro, haloalkyl, alkyl, amino, acylamino, imidate and phosphonato groups; or an acid addition salt, quaternary ammonium salt or N-oxide derived therefrom; or an effective amount of a composition comprising a compound of formula (I), as hereinbefore defined, and an insecticidally, acaricidally or nematocidally acceptable carrier or diluent therefor.

2. A method as claimed in claim 1 wherein A is CH_2CH_2.

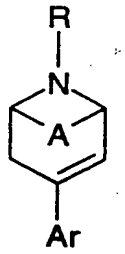
3. A method as claimed in claim 1 or 2 wherein Ar is phenyl, pyridinyl, pyridazinyl or pyrazinyl, all being optionally substituted with halogen, C_{1-4} alkyl, C_{1-4} alkoxy, C_{2-4} alkenyl, C_{2-4} alkynyl or cyano.

4. A method as claimed in claim 1, 2 or 3 wherein R is hydrogen, $CO_2(C_{1-4}$ alkyl), C_{1-4} alkyl (optionally substituted with cyano, $CO_2(C_{1-4}$ alkyl) or phenyl (itself optionally substituted with halogen, C_{1-4} alkyl, C_{1-4} alkoxy, C_{1-4} haloalkyl or C_{1-4} haloalkoxy)), or CH_2R^1, and R^1 is C_{1-4} haloalkyl, C_{2-4} alkenyl or C_{2-4} alkynyl.

5. A method as claimed in claim 1, 2, 3 or 4 wherein the pests are insect pests of growing plants.

6. An insecticidal, acaricidal or nematicidal composition comprising an effective amount of a compound of formula (I) as defined in claim 1, and an insecticidally, acaricidally or nematicidally acceptable carrier or diluent therefor.

7. A compound of formula (I):



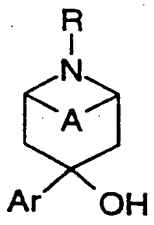
(I)

wherein A is WXC-CYZ or XC=CY; Ar is pyridyl optionally substituted with halogen; R is hydrogen, $CO_2(C_{1-4}$ alkyl), C_{1-4} alkyl (optionally substituted with cyano, $CO_2(C_{1-4}$ alkyl) or phenyl (itself optionally substituted with halogen, C_{1-4} alkyl, C_{1-4} alkoxy, C_{1-4} haloalkyl or C_{1-4} haloalkoxy)), or CH_2R^1, and R^1 is C_{1-4} haloalkyl, C_{2-4} alkenyl or C_{2-4} alkynyl; W, X, Y and Z are, independently, hydrogen, hydroxy, acyloxy, alkoxy, alkylsilyloxy, cyano or halogen; or an acid addition salt, quaternary ammonium salt or N-oxide derived therefrom.

8. A compound as claimed in claim 7 wherein A is CH_2CH_2; and Ar is pyridyl optionally substituted with halogen.

9. A compound as claimed in claim 7 or 8 wherein R is hydrogen, C_{1-4} alkyl or CH_2R^1, and R^1 is C_{1-4} haloalkyl, C_{2-4} alkenyl or C_{2-4} alkynyl.

10. A process for preparing a compound as claimed in claim 7 comprising dehydrating a compound of formula (II):



(II)

wherein Ar, A and R are as defined in claim 7.

INTERNATIONAL SEARCH REPORT

Int. ..tional Application No
PCT/GB 98/00693

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C07D451/00 A01N43/34 C07D451/02 A61K31/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C07D A01N A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	WO 97 13770 A (NEUROSEARCH) 17 April 1997 cited in the application see the whole document	1-7
A	GB 2 247 886 A (JOHN WYETH &BROTHER) 18 March 1992 cited in the application	1-7
A	WO 94 13659 A (LUNDBECK) 23 June 1994 cited in the application see the whole document	1-7
A	MAURI LOUNASMAAET AL: "UNE SYNTHÈSE EFFICACET RAPIDE DE L'ISOBELLENDINE" TETRAHEDRON LETTERS, vol. 22, no. 51, - 1981 pages 5179-5180, XP002067621 cited in the application	1-7

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 June 1998	30/06/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Luyten, H

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte .onal Application No
PCT/GB 98/00693

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication.where appropriate. of the relevant passages	Relevant to claim No.
A	DALE L. BOGER ET AL: "THERMAL CYCLOADDITION....." J,ORG. CHEM., vol. 49, no. 23, 1984, pages 44405-4409, XP002067620 cited in the application ---	
A	DAVID B. REPKE: "ABBREVIATED IBOGAINE CONGENERS" J.ORG. CHEM., vol. 59, no. 8, - 1994 pages 2164-2171, XP000611217 cited in the application PAGE2165,SCHEME 1 ---	1-7
A	KUR FRETER: "3-CYCLOALKENYLINDOLES" J.ORG.CHEM., vol. 40, no. 17, - 1975 pages 2525-2529, XP000612178 cited in the application PAQGE2527,FORMULA N, -----	1-7

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte onal Application No
PCT/GB 98/00693

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9713770 A	17-04-1997	AU 7291796 A	30-04-1997
GB 2247886 A	18-03-1992	US 5204470 A	20-04-1993
WO 9413659 A	23-06-1994	AU 675263 B	30-01-1997
		AU 5561894 A	04-07-1994
		CA 2151378 A	23-06-1994
		CZ 9501517 A	17-01-1996
		EP 0673375 A	27-09-1995
		FI 952824 A	08-06-1995
		HU 73632 A	28-08-1996
		JP 8504410 T	14-05-1996
		MX 9307779 A	30-06-1994
		NO 952275 A	03-08-1995
		NZ 258117 A	27-08-1996
		SK 76195 A	08-11-1995
		US 5753661 A	19-05-1998
		ZA 9309203 A	08-08-1994